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ABSTRACT

Swedes in four different age groups (9, 12, 15 and 18 years) judged written words which varied in three dimensions: syntactic category, objective frequency, and polysemy (multiple meaning). The subjects judged ease of comprehension of 24 words in a factorial arrangement. The method used was Thurstone's paired comparisons. A predicted complex relationship among the three independent variables, e.g. a triple interaction, could not be supported. Subjects in older ages did not seem to have a finer discrimination ability for words with different degrees of polysemy. It was concluded that the phenomenon of polysemy has to be incorporated in research on word comprehension. This approach avoids the current normative approach and leads to a more relevant starting point where semantic invariance must be substituted for semantic variability. (Author)

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Abstract

Four different age groups (9, 12, 15 and 18 years) judged words which varied in three dimensions: syntactic category, objective frequency and polysemy (multiple meaning). The subjects judged ease of comprehension of 24 words in a factorial arrangement, and the method was Thurstone's paired comparisons. A predicted complex relationship between the three independent variables e.g. a triple interaction could, however, not be supported. Subjects in older ages did not seem to have a finer discrimination ability for words with different degrees of polysemy. It was concluded that the phenomenon of polysemy has to be incorporated in research on word comprehension. This approach avoids the current normative approach and leads to a more relevant starting-point where semantic invariance must be substituted for semantic variability.

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The predominant research strategy as regards word comprehension has sometimes been criticized for being too normative (see Barclay et al, 1974 or Backman, 1978 c). Studies and experiments are for example based on a latent assumption of words having invariant semantic qualities. Such a basis leaves, e.g., out the phenomenon of polysemy, i.e. a word having multiple meanings. There is a variability for words which has demonstrable psychological semantic consequences (Backman, 1978 c), but these are, however, not predictable from current theories.

Research on word comprehension has also been accused of maintaining "noun categorization" as a paradigm in the experiments. Various techniques are used to determine "semantic distances" between words which belong exclusively to one syntactic class - nouns. There are, however, no theoretical reasons justifying a biased interest in a particular linguistic word class.

A recent study (Backman, 1978 c) has to a limited extent tried to remedy the above deficiencies by means of a simultaneous variation of polysemy and syntactic category. Nouns, verbs, and degree of polysemy were allowed to operate in the same experiment together with a third well-known influential variable - objective frequency. One of the experiments confirmed a predicted triple interaction between the three factors. An activity assumed to be complex multidimensional cognitive is rendered and is accordingly elucidated in a more

representative way in designs which makes it possible to analyze interactions. This experimental strategy also provides room for what Barclay et al (1974) call "semantic flexibility" or what in other connections (Backman, 1978 c) has been called the "variance hypothesis".

This experiment was partly made with the aim of supporting earlier findings and can thus be regarded as replications of a previous study (Backman, 1978 b). A triple interaction was predicted by means of a simultaneous variation of the above-mentioned factors (syntactic category, multiple meaning, and objective frequency). Syntactic category was found to interact with frequency (Backman, 1978 a). The verbs were more resistent to the introduction of a new variable - multiple meaning - than nouns, since the former are context dependent. The nouns do not require any further linguistic elements, but they are related to multiple meaning (number of variants) when they are estimated in isolation.

The study is, however, also extended to include different age groups, and it can consequently also in part be seen as a devoelopmental study. Language development is usually regarded as a continuous process which sometimes is not even finished for adults. There is a certain agreement with the "Semantic Feature" hypothesis (Clark, 1973): children gradually acquire an increasing number of features of meaning of words.

Semantic knowledge is acquired by means of *"... adding more features of meaning to the lexical entry of the word until the child's combination of features in the entry for that word corresponds to the adult's"* (Clark, 1973).

The older the child grows he accordingly aquires an increasing number of and more differantiated features for a word. The hypothesis also implies that words which have an overlap of meaning will not be discriminated by children but will be regarded as having the same meaning (e.g. BOY-BROTHER). Clark's hypothesis does not include multiple meaning in the sense of polysemy but it seems reasonable to assume that it is also possible to translate the hypothesis to this kind of more subtle multiple meaning. From this will then follow a prediction of the lack of triple interaction for lower ages. The introduction of the variable multiple meaning will in other words not change an earlier verified interaction between syntactic category and frequency. It is assumed that younger children are not able to discriminate changes in the latter variable.

METHOD AND PROCEDURE

Verbal material

Twenty-four different words were used in the experiment, words which were identical with those used in an earlier experiment (Backman, 1978 b). They were distributed on three different objective frequency

levels (OF), two syntactic categories (N = noun and V = verb), and four multiple meanings (Mm 1-4). The words in Table I thus present a three factorial design with the levels 2 x 3 x 4. Table I also presents modified frequency (see Allén, 1970) and rank number for the words. The translations to English are of course not accurate reflections of the Swedish polysemous characters.

Response technique

The subjects were asked to rate comprehension in paired combinations by marking the word which they considered easiest to understand in every pair. The data processing was made with Thurstone's paired comparisons but with proportions transformed to angular deviates (see Bock & Jones, 1968).

Subjects

Four age levels of 174 subjects in all were tested and the distribution was as follows: 9-year-old pupils (grade 3) 33 subjects, 12-year-old pupils (grade 6) 44 subjects, 15-year-old pupils (grade 9) 48 subjects and 17-18-year-old pupils (grade 2 upper secondary school). The experiment was carried out during ordinary lessons and took about one hour.

RESULTS

Angular proportions were subjected to a three-way ANOVA (fixed factors) for every age group. The results are presented in Tables II and III. Computations for degress of freedom are based on the error term for

Table I. Words included in the experiment, their syntactic category (SC, N = noun, V = verb). Number of multiple meanings (Mm), objective frequency (OF) and order of rank (R-no).

Word	SC	Mm	OF	F-mod	R-no
GRUNDVAL/FOUNDATION	N	1	37	29.69	2513
SKÄNKA/GIVE	V	1	37	28.11	2513
VÄNTAN/WAIT	N	2	37	32.42	2513
GLIDA/GLIDE	V	2	37	32.05	2513
LÄGER/CAMP	N	3	37	29.12	2513
DIRIGERA/CONDUCT	V	3	37	28.75	2513
SVAGHET/WEAKNESS	N	4	37	31.76	2513
SPARA/SAVE	V	4	37	29.91	2513
TILLVARO/EXISTENCE	N	1	82	69.46	1296
UPPREPA/REPEAT	V	1	82	67.76	1296
PERIOD/PERIOD	N	2	82	63.87	1296
TYDA/INTERPRET	V	2	82	63.73	1296
UTRYMME/SPACE	N	3	82	76.02	1296
LIDA/SUFFER	V	3	82	79.68	1296
PERSPEKTIV/PERSPECTIVE	N	4	83	70.98	1279
RYMMA/HOLD	V	4	83	72.23	1279

Table I

cont.

Word	SC	Mm	OF	F-mod	R-no
HAND/HAND	N	1	482	473.4	188
VETA/KNOW	V	1	547	600.1	137
FÖRFATTARE/AUTHOR	N	2	536	464.2	170
ANVÄNDA/USE	V	2	458	428.2	202
BEHÖVA/NEED	V	3	543	526.1	165
ARBETE/WORK	N	4	512	475.3	178
BÖRJA/BEGIN	V	4	760	732.6	118

numbers of words (24) and according to (n-1)(n-2)/2. If we observe MS we see that the triple interaction on all age levels contributes a large part of the variability compared with the other sources. All effects in the analyses on the various age levels are significant ($p < .001$). Figure 1 exemplifies the complex relation between the three variables. Age group 18 has been selected since this according to Clark's hypothesis has the most stable and differentiated representation of the word. The illustrated relations are, however, approximately the same in the four age groups.

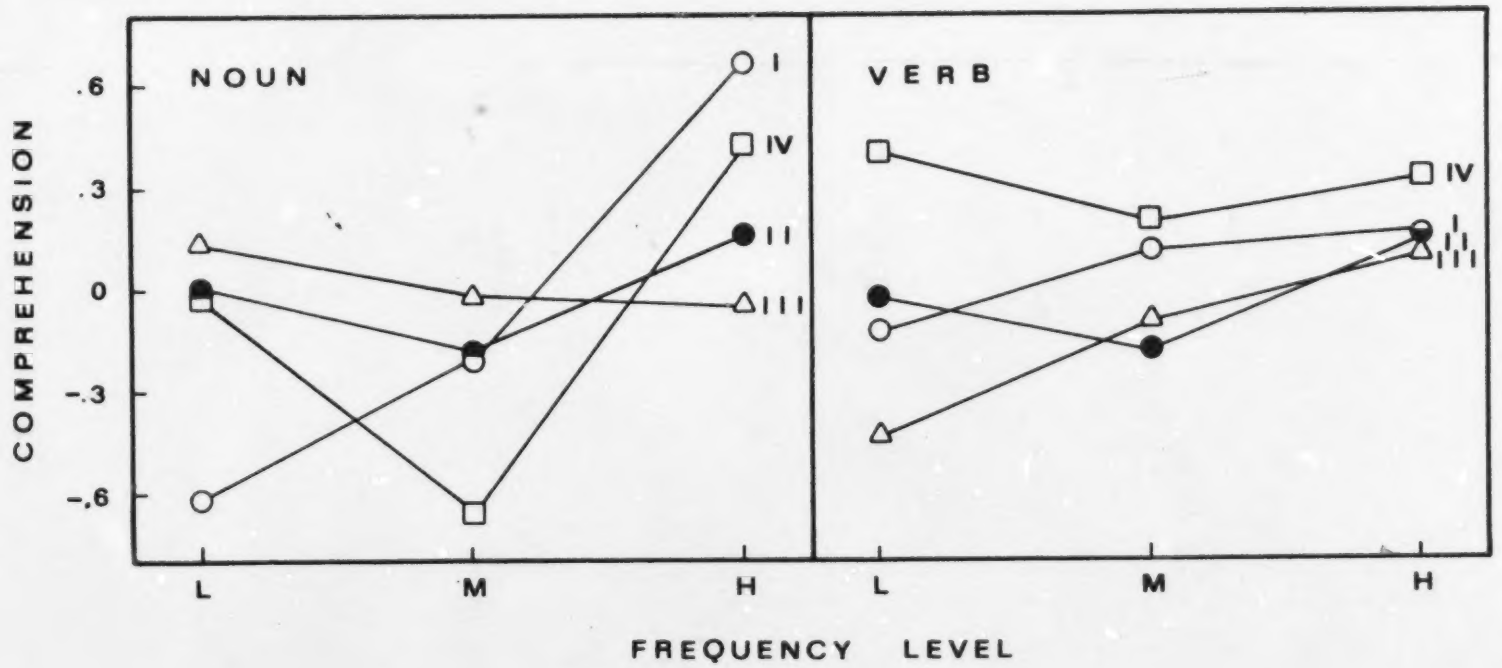

Figure 1. Comprehension values (angular deviates) for nouns and verbs at different frequency levels with multiple meaning as parameter.

Table II. Degrees of freedom (df) and mean squares (MS) for different sources of variance and age levels (index).

Source of variance	df	MS_9	MS_{12}	MS_{15}	MS_{18}
Multiple meaning (Mm)	3	.82	.34	.77	1.35
Objective frequency (OF)	2	8.20	9.37	7.65	13.09
Syntactic category (SC)	1	1.27	4.45	5.23	9.72
Mm x OF	6	2.15	1.40	1.43	2.99
Mm x SC	3	2.11	4.29	2.82	7.46
OF x SC	2	1.86	2.12	2.49	2.95
Mm x OF x SC	6	2.11	6.38	3.61	5.18
Error	253	0.03	0.03	0.03	0.05

Table III. F-quotients for different sources of variance on various age levels (index) where p always is < .001.

Source of variance	F_9	F_{12}	F_{15}	F_{18}
Multiple meaning (Mm)	28.43	12.98	29.64	30.28
Objective frequency (OF)	275.14	354.53	295.48	200.30
Syntactic category (SC)	204.30	168.27	201.92	25.03
Mm x OF	62.97	53.07	55.36	78.63

Table III

cont.

Source of variance	F_9	F_{12}	F_{15}	F_{18}
Mm x SC	156.78	162.53	109.07	77.35
OF x SC	62.10	80.10	96.22	68.21
Mm x OF x SC	108.94	241.48	116.36	77.28

The similarity in the outcome led to the examination of the agreement in angular proportions between the age levels in the form of correlation coefficients. Table IV presents product moment coefficients and they provide information of a remarkable stability over ages.

Table IV. Intercorrelations for age levels determined according to proportions.

Age	12	15	18
9	.97	.97	.91
12		.96	.91
15			.92

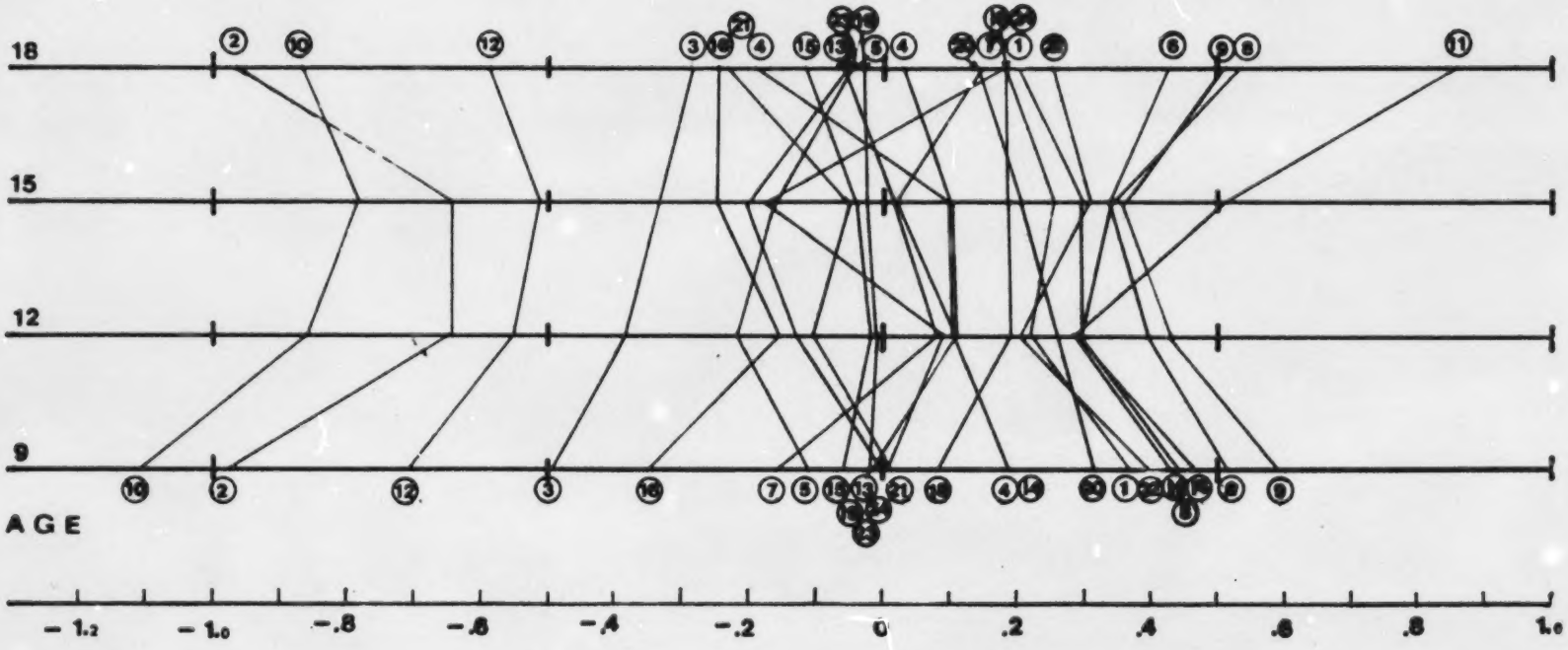

Figure 2. Angular proportions for the different words at the four age levels.

Figure 2 presents proportions for all four age levels and we can see that four words are quite distinct from the others: the four words with the lowest proportions, i.e. those words that are most difficult to understand. Their ordinal relations are furthermore approximately constant over age levels. The same is true of the four easiest words, although not so strikingly. This is presented separately in Figures 3 and 4. To sum up, there is a great deal of agreement in estimating different ages. The figures also show that the highest degree of correspondence can be found between the highest and the lowest age level. This contradicts Clark's (1973) feature hypothesis. The hypothesis means in proportion data that differentiation and separation of the proportions of comprehension increase with age. An analysis of the estimations of difficult and easy words and of the length of the judgment scale shows that in the cases where the difference between the ages has been predicted to be greatest it is in fact the reverse. This should, however, be noted with a certain reservation since the difference of variance between the ratings of the highest and lowest age group is significant, $(23,23) = 2.10$, $.01 < p < .05$. The variance in the lowest group is about twice as big as in the other groups.

With the aim of testing the theoretical formulation for the three-way interaction, data were grouped so that Mm 1 and 2 were combined in one Mm-group,

Mm_L and Mm 3 and 4 were put together in Mm_H. This is justified by previously presented resuts (Backman, 1978 c), were a discrimination limit was obtained between 2 and 3 for number of multiple meanings. Figure 5 and 6 presents the SC-OF interactions for the two Mm-groupings. The interaction for Mm_L (figure 5) is identical with that which was obtained in an earlier experiment (Backman, 1977). No interaction was predicted for higher numbers of Mm. Tukey tests on column sums with Dunncorrection (see Keppel, 1973) between N and V on every frequency level result, however, in significance on the middle frequency level (as in the predicted direction on all three frequency levels at Mm_L) at $p < .01$. There is, however, no significance for the low and high frequency levels. The outcome verifies nevertheless in 5 of 6 multiple comparisons the theoretical reasons for an interaction of a higher order.

DISCUSSION

The verified first prediction supports the previously presented context theory as a basis for a distinction between nouns and verbs. The relative context dependance of the verbs in the form of accessibility to further syntactic elements for distinct semantic representations makes them more or less resistent to Mm-manipulations. The nouns, which thus are more unambiguous for representation because of their non-relational character, are supposed to be related to number of multiple meanings.

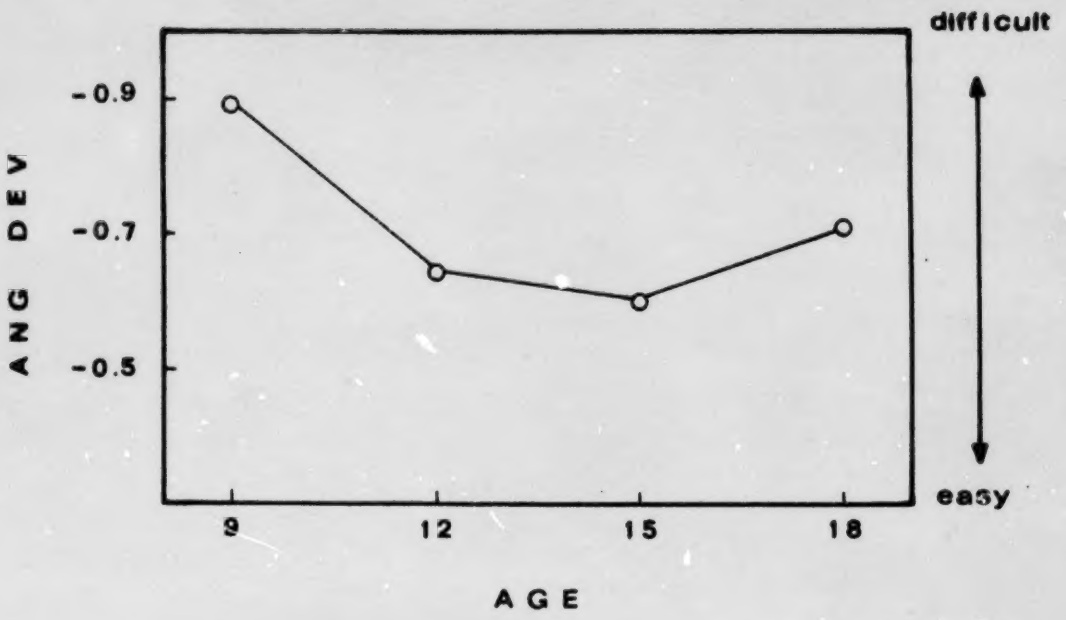

Figure 3. Angular deviates for the four words with the lowest proportion values.

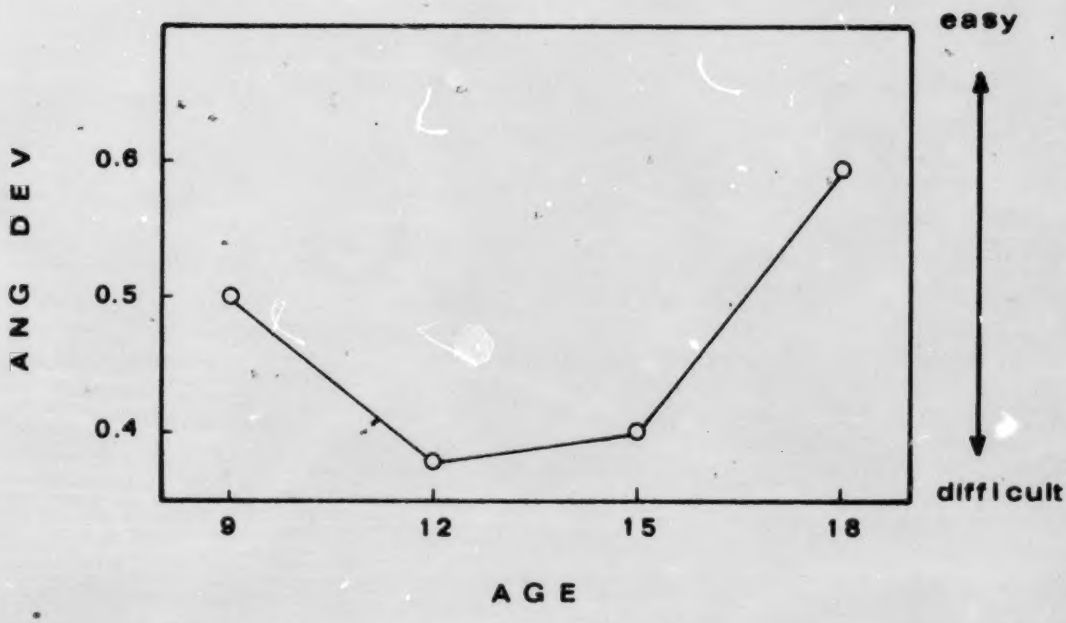

Figure 4. Angular deviates for the four words with the highest proportion values.

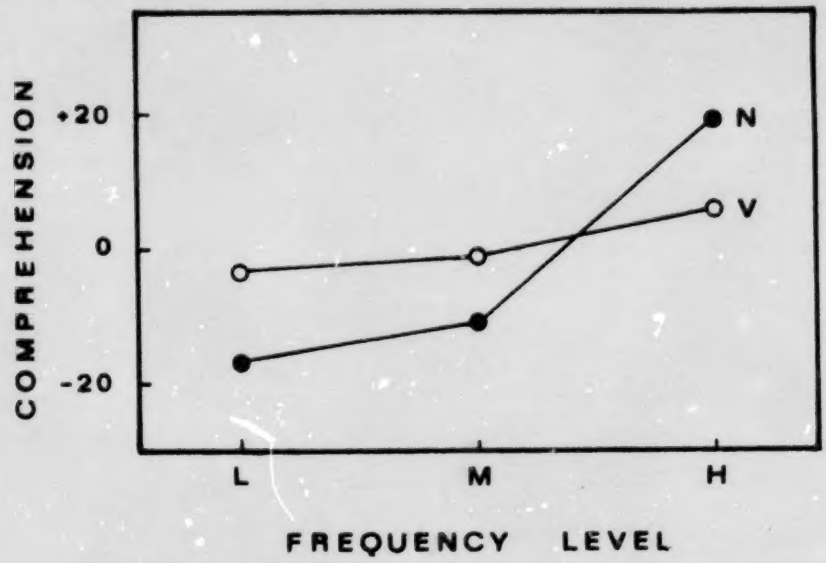

Figure 5. Comprehension values (column sums of angular proportions) for words with 1-2 meanings at different frequency levels.

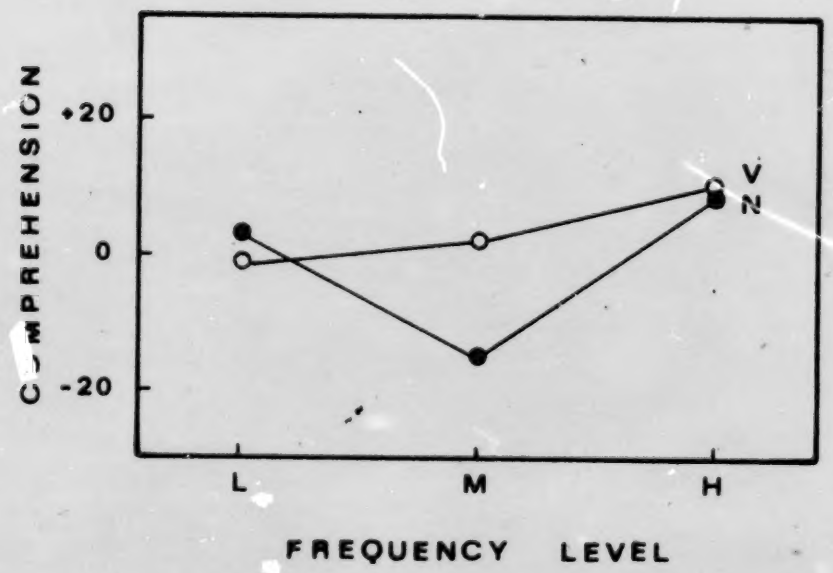

Figure 6. Comprehension values (column sums of angular proportions) for words with 3-4 meanings at different frequency levels.

An increasing number of Mm results in an increasing number of "entries" in the semantic memory. This can be illustrated by the following example. The verb THROW requires a complementary element for a specific interpretation: THROW (a stone) (up) etc. In the absence of such complementary elements, the verb will probably have a diffuse and indefinite representation, or in other words freedom of choice in a hypothetical context. This can be compared with for example the word STONE which, from a linguistic point of view, can be interpreted relatively isolated from context. Numbers of multiple meanings are, however, indicators of possible contexts and of access in the semantic memory. In order to make the nouns comparable as regards comprehension, the former should accordingly be given higher access by introducing more multiple meanings.

The other derived prediction from Clark's (1973) hypothesis cannot be verified. Multiple meaning was supposed to be without effect on the SC-OF-interaction for the lowest age group. The 9-year-old pupils manifested, however, the same linguistic "competence" as the oldest age group (and provided, in other words, unexpected support of the first prediction). It should, however, be pointed out that the hypothesis has been transformed to a situation for which it is probably not supposed to be predictive.

To sum up we observe that

a) intersyntactic comparisons are possible to make via direct ratings of word comprehension - an intersyntactic judgment dimension

b) the "context theory" with polysemy as indicator of context predicts comprehension and a difference between verbs and nouns in cognitive representation

c) judgment of individual words is a multidimensional activity with complex relations.

Continued research should incorporate multiple meaning as an independent variable. This may be a way of avoiding the stereotype "noun categorization" and the parallel activity of the linguists which Labov (1973) calls "categorical view". The approach presented in this report, where the invariance of the individual word has been substituted by variance, is probably also in closer agreement with criteria of relevant verbal circumstances.

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